

MULTICS

SOFTWARE

Multics is a large-scale, time-sharing system that multiplexes system resources among the jobs of many users. Because the administration of system resources in any large time-sharing system involves various time-consuming clerical tasks and control measures, Multics features a decentralization capability that makes these tasks easier to perform and offers the user better service for each dollar spent.

Multics administration defines three distinct levels of responsibility: *system*, *project*, and *user*. These levels are arranged like a pyramid (see illustration) with system administration at the top. A system administrator allocates system resources among the projects within his system, and a project administrator allocates these resources among the users on his project. Each user, in turn, can manage his own data through storage management and access controls. Because detailed supervisory tasks are shared and administrative bottlenecks are eliminated, the decentralized structure of Multics offers advantages to both the administrators and the users.

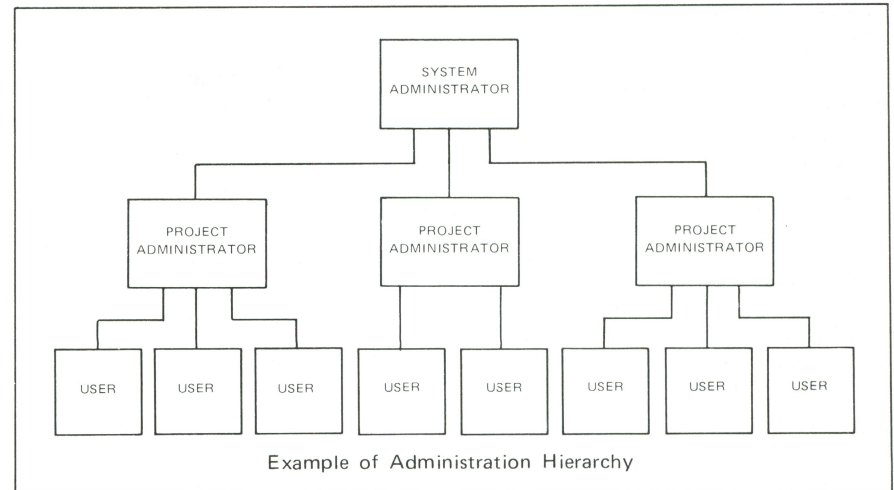
SYSTEM ADMINISTRATION

The system administrator has several system management capabilities exclusively his own.

Resource Control

In the area of resource control, he:

- Establishes the system configuration and operating parameters.
- Defines which projects are on the system and how much secondary storage quota each is allowed.
- Assigns projects to a load control group so each one can have a fair share of system access.
- Names project administrators and sets project attributes that each project administrator can distribute among his users.



Accounting Procedures

In the area of accounting procedures, he:

- Maintains records of system usage so projects can be billed for only the actual use of resources—not the estimated use.
- Can set prices on interactive (cpu time for eight shifts, memory usage, and connect time) and absentee¹ (cpu time for four queues, memory usage, and connect time) usage, I/O (for four queues), disk storage, user registration fee per project, etc.
- Can use either the standard Multics accounting procedures or procedures of his own design.
- Can access accounting records of the whole system.
- Can generate usage reports and bills for each project at any time without interrupting Multics service.

Security

For security purposes, the system administrator:

- Registers projects, users, and initial user passwords.

- Uses an advanced security feature of Multics called ring protection to define the rings in which a project can operate. Ring protection is an extension and refinement of the basic access control.

PROJECT ADMINISTRATION

The project administrator also has several system management capabilities exclusively his own. The system administrator performs these functions if a project administrator is not assigned.

Resource Control

In the area of resource control, the project administrator:

- Works with the resources allocated to him by the system administrator.
- Adds and deletes system-registered users from his project at will.
- Can add anonymous users (users on his project who are not registered on the system).
- Distributes the secondary storage among his users.
- Sets access to his users' directories.

(continued)

Specifications may change as design improvements are introduced.

- Can perform all his administration functions remotely from his own terminal. (Any change made by the project administrator takes effect *immediately*.)

Resource Usage Monitoring

In order to monitor resource usage, the project administrator:

- Has access to all system accounting data concerning his project.
- Has access to system programs to get month-to-date usage figures for each user on his project.
- Can determine effective usage of the system by comparing the cpu and connect time by shift.
- Can monitor the secondary storage usage (actual usage versus assigned quota) of each user on his project.

Environment Shaping

Finally, in order to shape the overall environment, he:

- Can give all users full system capabilities or can restrict any user on his project to either the Limited Service System or a closed subsystem. (A closed subsystem may duplicate a totally different system so that the user would need little, if any, knowledge of Multics.)
- Can, if given authority by the system administrator, give any user on his project special attributes. For example, he may allow a user guaranteed access to the system when he logs in or allow him to be preempted by another user.
- May set user dollar limits by month or shift or set user cutoff limits by date or dollar charge. If a logged-in user

exceeds his limit, he is given a three-minute warning before being logged off the system.

USER CAPABILITIES

There are several administrative functions available to the user.

Resource Usage Monitoring

To monitor resource usage, the user:

- Checks his own use of resources, including total dollar usage, cpu and connect time by shift, I/O usage, and absentee usage.

Access Control

- Specifies precisely to whom and with what access mode (read, write, or execute), part or all of his data is available.
- Can grant or revoke access at any time with a simple command, which goes into effect *immediately*.

User Management

To manage usage, the user:

- Can create directories under his own home directory for his convenience. For example, he may wish to group programs or data either by category or under the same access control.
- May change his password or default project at log-in time if given authority by the system administrator.
- May specify how control will be transferred to his process at log-in time if given authority by the project administrator.

FEATURES

In summary Multics administration offers a variety of features:

Resource Distribution

- System configuration and operating parameters
- Disk quota
- Special attributes for users and projects

Accounting

- Pricing
- Billing operations
- Adjustable update periods

Usage Control

- Dollar limits by shift, month, or absolute
- Load control groups
- Real time versus cpu time (governor)
- Disk storage
- Dollar charge (absolute by project or user)
- Cutoffs by user, date, or dollar charge
- Project and user registration

Environment Shaping

- Full Multics
- Limited Service System
- Closed subsystems

Access Control and Security

- Password initially set by system administrator, changeable by user
- Person ID set by system administrator
- Project ID set by system administrator
- Person allowed on project by project administrator
- Access control by user and mode
- Ring protection

¹ Multics batch

HONEYWELL INFORMATION SYSTEMS